LESSON FAMILY TIES

About This Lesson

This lesson is comprised of three parts grouped to enable students to understand classification of organisms by developing organization charts of their own using simple cereal or candies.

Part 1 –

Students will classify imaginary organisms represented by a mix of breakfast cereals, candies, nuts, raisins, etc. according to similar characteristics. They will use a flow chart to show the characteristics by which they divided the organisms into groups.

Part 2 –

Students will classify a series of single-celled organisms using a dichotomous key.

Part 3 –

In this part, students will apply skills learned in Part 2 to create a dichotomous key for their specimens from Part 1.

Background

In the times of the ancient Greeks, the famous philosopher, Aristotle, created the first known scientific method of classifying living organisms. Based on the knowledge available to him at the time, he divided all living things into two basic groups: Plants and Animals. Plants, he then subdivided into herbs, shrubs, and trees. Animals were grouped according to where they lived: air, water, or land. The inherent flaw in this system is obvious to us today. Many organisms do not fit neatly into any of these groups. The invention of the microscope has also introduced humans to an entire world of living things that are unseen with the naked eye.

In 1753, the Swedish botanist, Carol Von Linne, first introduced the system upon which all modern classification is based. He called his system, *binomial nomenclature*, meaning "two-name naming system". He asserted that common names were not scientifically accurate, because often one organism went by different common names in different parts of the world. He also recognized that the same common name might be given to two completely different organisms. He therefore based his classification system on Latin. It was well known by educated people of the time, but was no longer in use as a constantly changing, everyday, spoken language. This meant that once an organism had been named according to its characteristics, the meaning of the name would not change. The first name that he changed was his own, which became Carrolus Linnaeus, the name by which he is more commonly known today.

Linnaeus was the first to recognize the species as the basic form of relationship among living things. He defined a species as a group of organisms having similar characteristics, which could reproduce with one another and have offspring, which could reproduce themselves as well. A Genus was a group of closely related species. Each division of classification used today fits neatly inside the next largest, like a series of nesting boxes. From largest category, to smallest, they are: Kingdom, Phylum, Class, Order, Family, Genus, and species.

Of the estimated 3-4 million forms of life on Earth, scientists have only identified and classified about 1.5 million. The living organisms on our world and those that may exist elsewhere in the universe remain mainly unidentified. What a challenge for future explorers!

Although Linnaeus' classification system still had only two Kingdoms: Plantae and Animalia, the most widely accepted modern system contains six. It has Plantae and Animalia as well as Fungi, Monera, Protista, and most recently, Archaea. Linnaeus and his compatriots were limited in how they could group organisms to only using those physical characteristics that were readily seen. With the advent of the microscope and the many forms of technology we have available today, classification has become much more precise. Groupings today are based not only on physical characteristics, but cellular, biochemical, and genetic relationships as well. Thus, the system by which we group living organisms has not remained static, but has been constantly changing, even as science itself has changed through time.

When scientists discover new organisms, the first step in classification is to make good observations of that organism's characteristics (see activity "Creature Feature"). Next, a comparison is made with known organisms exhibiting similarities. One way in which this can be done very simply is to use a dichotomous key. Dichotomy is when something is divided into two parts or types. When using a dichotomous key, the scientist merely starts at the top of the key with each new organism. He or she then follows a series of directions, which lead to increasingly more specific descriptions of the organism, ending when a group containing all of the relevant characteristics is found.

PART 1 –

About this Part

Categorizing and classifying objects is an innate human skill. This activity will help students focus on scientific classifications of organisms. Students will first classify imaginary organisms represented by a mixture of breakfast cereals and candy, raisins, nuts, raisins, etc.

Objectives

Students will:

- basic techniques used in classification.
- Analyze and discuss various methods of classification used by classmates.
- Classify organisms using a dichotomous key.
- Construct a dichotomous key.

Vocabulary List

classification, binomial nomenclature, dichotomous, Kingdom, Phylum, Class, Order, Family, Genus, species

Materials

- One plastic zip sandwich bag or paper cup for every 2-4 students
- One large bowl or container
- Single-serving size breakfast cereal variety pack, snack mix, candies, nuts, raisins, etc.
- Magnifying lenses or binocular microscopes
- Rulers or tape measures
- Crayons or colored pencils (One set per group)
- Paper towels or tissues
- Sample Classification Chart (One per group)
- Sample Dichotomous Key (One per group)
- Student Sheets A and B (One each per group)

Procedure

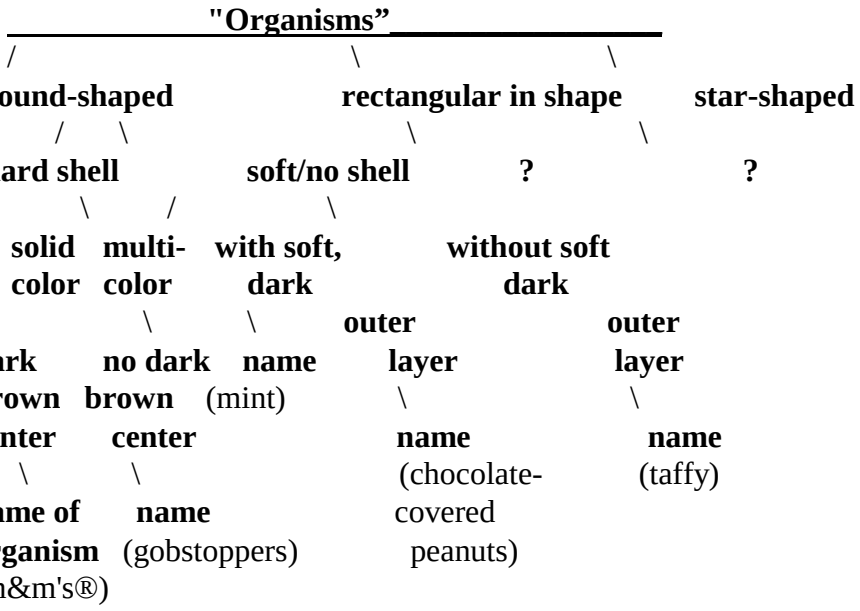
Advanced Preparation

1. Read background
2. Combine the different types of cereals, etc. in a large bowl or container and mix.
3. Place portions of mixture into each plastic bag or paper cup, one per group.
4. Make copies of Student Sheets,
   Optional: make copies of Sample Classification Charts, and sample Dichotomous Key.

Classroom Procedure

1. Place copies of Student Sheet – Classification Chart, several paper towels, a ruler, a magnifying lens, crayons or colored pencils, and portions of mixture at each table.
2. Direct students to follow Student Procedure on Student Sheet – Part 1 Classification Chart.
3. Remind students to reserve one of each specimen for use in Part 3.
4. If possible, allow students to eat remaining sample.

Sample Classification Chart -- Example for teacher or share with students.
(NOTE: Students should make up their own names for the organisms they classify, rather than using the candy names given in this example.)



Sample Biological Classification Key for teacher.

1. a. Organism is round	Go to number 2.
b. Organism is not round.	Go to number 3.
2. a. Organism is hard to the touch.	Go to number 4
b. Organism is soft to the touch.	Go to number 5
3. a. Organism is rectangular in shape.	Go to number 6.a.
b. Organism is star-shaped	Go to number 6.b
4. a. Organism has solid-colored shell	Name (M&M®)
b. Organism is multi-colored; no shell	Name (Peppermint)
5. a. Organism has dark coating	Go to number 7
b. Organism has no dark coating	Name (taffy)
6. a. Organism is brightly colored	Name (Starburst®)
b. Organism is tan or brown	Name (caramel)
7. a. Organism has brittle, tan, inner core	Name (Chocolate-covered peanut)
b. Organism has soft, dark, gummy-looking core.	Name (Chocolate-covered raisin)

Student Sheet Part 1
Page 2
Classification Chart

Procedure

1. Place the specimens provided onto the paper towels.
2. Observe the specimens for a brief amount of time, using magnification or measuring instruments to make your observations more accurate. Divide the specimens into two or three large groups or Domains based on their physical characteristics. (i.e., those that are brown and those are not).
3. Name the Domains. Do ***not*** use food words to describe the specimens. Fill in the names on the chart below.
4. Working with one Domain at a time, further divide and sub-divide the domains until you have only identical organisms in each of the subgroups.
5. At each stage of division, record on the chart the characteristic you used to divide the specimens into the next smaller group (i.e.: spherical, rectangular, star-shaped, etc.). Continue to not use food terms. It may not be necessary for you to use all of the spaces provided, or, if needed, you may add spaces or recreate the chart in a larger format
6. As you classify the specimens, make a simple color sketch of each specimen.
7. Reserve one of each type of specimen.

Name for specimens: _____

Domain I. **Domain II.** **Domain III.**

PART 2 –

About this Part

Students will classify a series of single-celled organisms using a dichotomous key to identify them.

Objectives

Students will: construct a dichotomous key .

Materials

- Protist Identification cards (one set per group)
- Dichotomous Key (one per student)
- Student Sheet for Part 2 (one per student)
- Map pencils or crayons (one set for teacher)
- Envelopes (one per group)

Procedure

Advanced Preparation

1. Make enough copies of the sheet containing the Protist Identification Cards for each group to have a set.
2. Color all of the organisms labeled "Plant-like Protists" green. (If possible, have sheets laminated to make them sturdier.)
3. Cut Protist cards.
4. Place a set of Protist cards into each envelope. *(Note: For younger students, you may want to give each group only four or five of the cards.)*
5. Optional: Make enough copies of the dichotomous key and student sheets for every student.

Classroom Procedure

1. Divide students into groups of 3-4.
2. Distribute the envelopes to students, along with copies of the Part 2. Student Sheet and the Dichotomous key.
3. Have students read the background information on their Student Sheets and follow the directions given for using a dichotomous key. Emphasize that they must start again at the top of the key each time they begin to identify a different organism.
4. Ask students to raise their hands when they feel like they have successfully identified the organisms on their Identification cards.
5. Walk around the classroom, either verifying their answers, or helping them to double-check the pathway they followed through the dichotomous key when identifying the organisms.
6. When students have successfully identified the Protists on their Identification Cards, they will answer the follow-up questions.

Background:

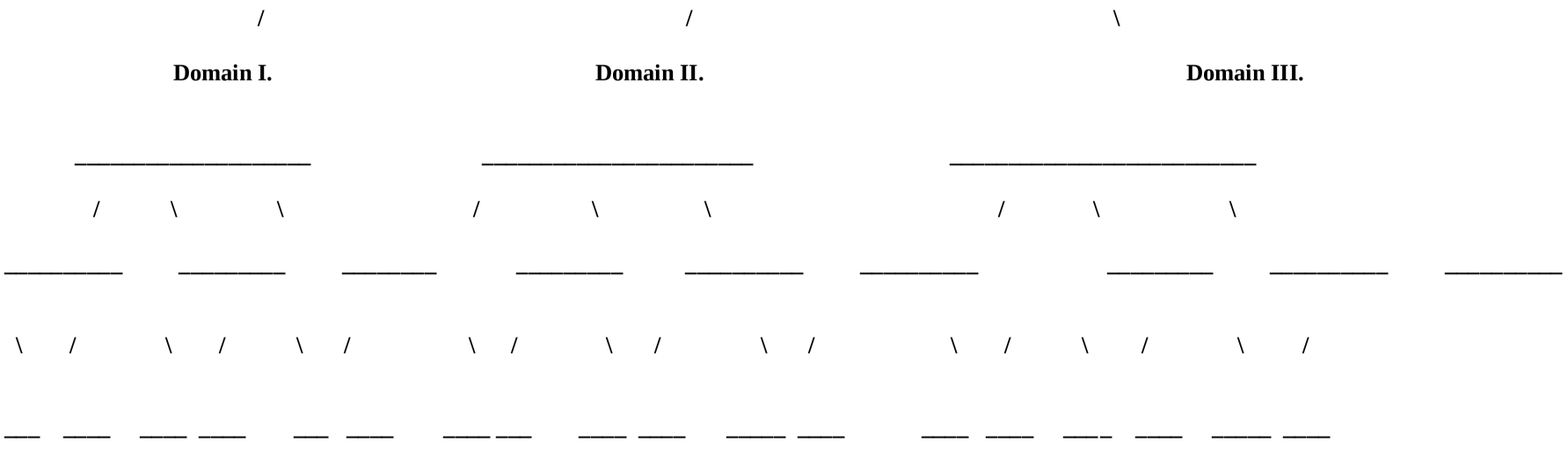
The classification and taxonomy (identifying and naming) of organisms has changed dramatically throughout the centuries, evolving from a simple, two-kingdom system into a complex web of connections. From grouping organisms by physical characteristics, the process has now been highly refined, using DNA technology as well as cellular and biochemical relationships. Scientists can determine how closely organisms are related to one another with close to 100% accuracy.

Good observations are the first step. First, scientists look at the outward physical appearance. Next, a comparison is made with known organisms showing similar characteristics. One way in which this can be done is using a dichotomous key. Dichotomy is when a group of things is divided into two parts or types. In classification, the process continues by splitting those groups into smaller and smaller ones, until each organism is in a group containing only individuals with the same characteristics. This level is called a species. A scientific name consists of two parts, the genus and the species, written in Latin or Greek and describing the organism in some way. An example is the scientific name for a modern human: *Homo sapiens*. The genus name is capitalized and the species name is not. Both are either written in italics or underlined (Homo sapiens).

Student Sheet Part 2
Page 2
Classification Chart

1 Observe the Protist Cards for a brief amount of time. Divide the specimens into two or three large groups or Domains based on their physical characteristics.
2. Name the Domains. Fill in the names on the chart below.
3. Working with one Domain at a time, further divide and sub-divide the domains until you have all organisms in a subgroup.
4. At each stage of division, record on the chart the characteristic you used to divide the specimens into the next smaller group. It may not be necessary for you to use all of the spaces provided, or, if needed, you may add spaces or recreate the chart in a larger format

Name for specimens: _____



Student Procedure

1. Sort the Protists cards into Domains using your skills from sorting items in Part 1. Remember to make them large groupings.
2. Note characteristics that you would use to separate the Domains into smaller groups.
2. Refer to the Sample Dichotomous Key and the steps below to arrange a dichotomous key of the Protists. Notice the different format for the same type of information that was recorded in Part 1.
2. Use the Chart that you made in Part 1 to remember the characteristics used to divide and subdivide the "organisms" into increasingly specific groups.
3. Starting at the top of the template on the Part 3 Student Sheet, take the first characteristic you used to divide the organisms and use it to write “present” or “absent” statements, 1.a. and 1.b. (Example 1.a. Round 1.b. not round)
4. At the end of statement 1.a., write the directions, "Go to statement 2."
5. On statement 2, choose the next characteristic that you used to divide 1.a. into two groups and write its presence or absence on statements 2.a. and 2.b.
6. Continue following the further divisions of group 1.a. until all organisms in that line are in a group by themselves and named.
7. At this point, go back to the top of the key and follow the above steps for all organisms that fall into group 1.b.
8. When your team has finished the key, trade it with another group that is finished. Provide the other group with the reserved organisms from Part 2.
9. Students in the other group should attempt to follow the first team's key and identify the organisms.

STUDENT SHEET PART 2 AND PART 3

Dichotomous Key: _____ Part 2 page 4 or _____ Part 3 (check which activity)

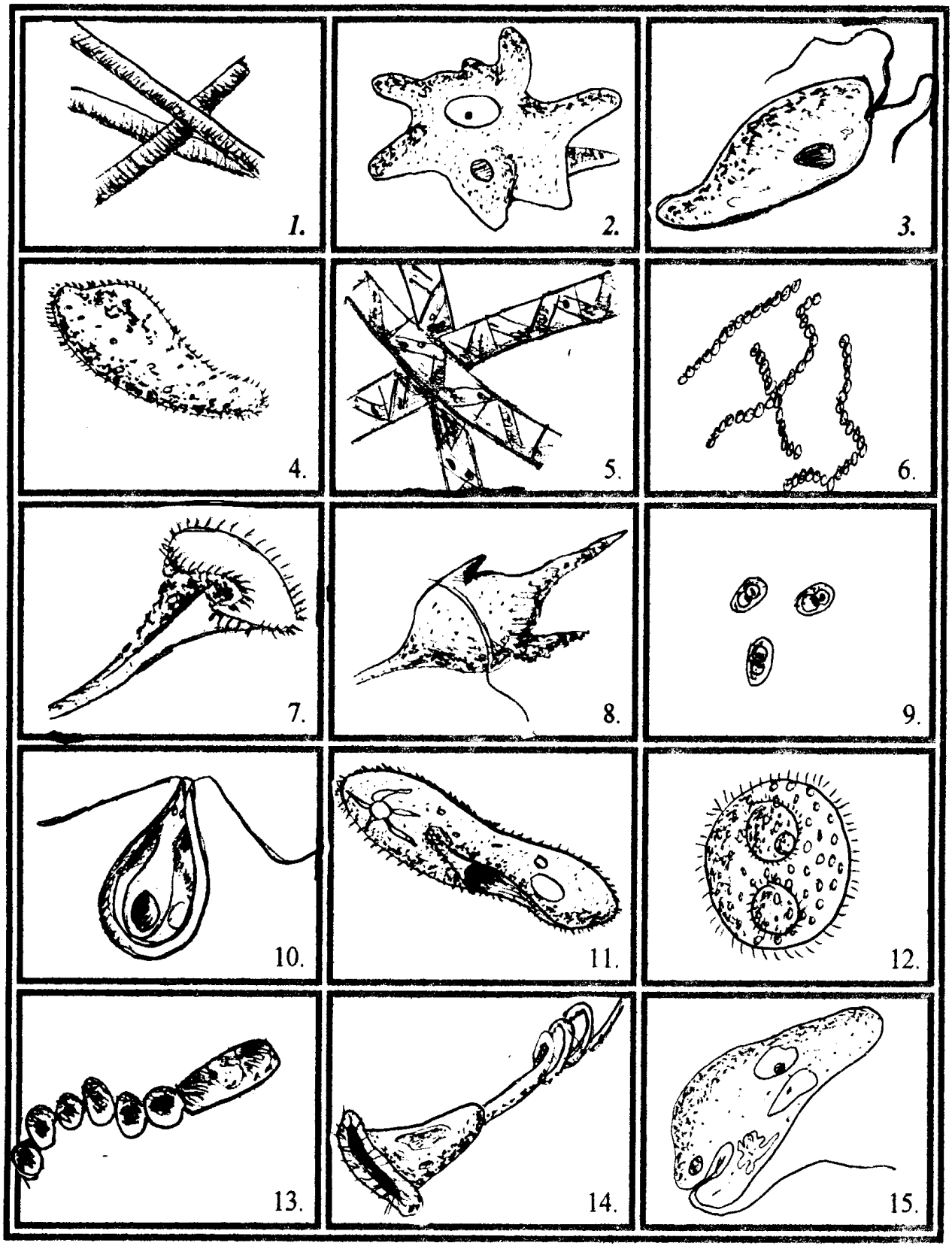
Procedure: It may not be necessary for you to use all of the numbers provided. If needed, you may create more numbered levels. Biological keys, once constructed, are often used to identify unknown organisms.

1. a.
   b.
2. a.
   b.
3. a.
   b.
4. a.
   b.
5. a.
   b.
6. a.
   b.
7. a.
   b.
8. a.
   b.
9. a.
   b.
10. a.
    b.

PROTIST IDENTIFICATION

Protist Identification for Cards

1. Oscillatoria/plant-like/filamentous/colonial
2. Amoeba/animal-like/amorphous/single cells
3. Chilomonas/animal-like/flagellated/single cells
4. Blepharisma/animal-like/ciliated/single cells
5. Spirogyra/plant-like/filamentous/colonial
6. Nostoc/plant-like/chain-like/colonial
7. Stentor/animal-like/ciliated/single cells
8. Ceratium/plant-like/flagellated/single cells
9. Gleocapsa/plant-like/individual cells
10. Chlamydomonas/animal-like/flagellated/single cells
11. Paramecium/animal-like/ciliated/single cells
12. Volvox/plant-like/ciliated sphere/colonial
13. Anabaena/plant-like/chain-like/colonial
14. Vorticella/animal-like/ciliated/single cells
15. Euglena/plant-like/flagellated/single cells


1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.

Dichotomous Key of Protists

1. a. Contains green pigment.	go to 2
b. Does not contain green pigment.	go to 3
2. a. Lives in a colony.	go to 4
b. Does not live in a colony.	go to 5
3. a. Has cilia or flagella	go to 6
b. Has no cilia or flagella.	Amoeba
4. a. Colony is long and filamentous.	go to 8
b. Colony is spherical.	Volvox
5. a. Has a flagellum.	go to 7
b. Does not have a flagellum.	*Gleocapsa*
6. a. Has cilia.	go to 9
b. Has flagella.	go to 10
7. a. The flagellum is at one end.	*Euglena*
b. The flagellum wraps around it's equator.	*Ceratium*
8. a. Filament of cells is tube-like.	go to 11
b. Filament of cells is like a string of beads.	go to 12
9. a. Cilia cover the entire outer surface.	go to 13
b. Cilia surround only an opening at one end.	go to 14
10.a. Pear-shaped with a posterior nucleus.	*Chlamydomonas*
b. Slipper-shaped with a central nucleus.	*Chilomonas*
11.a. Has spiraled strips of chloroplasts.	*Spirogyra*
b. Does not have chloroplasts in spirals.	*Oscillatoria*
12.a. All bead-like cells are the same size.	*Nostoc*
b. Some bead-like cells are longer than others.	*Anabaena*
13.a. Cell has a star-shaped vacuole at one end.	*Paramecium*
b. Cell does not have a star-shaped vacuole.	*Blepharisma*
14.a. Has a spiraled, stem-like structure.	*Vorticella*
b. Does not have a spiraled stem-like structure.	*Stentor*

PART 3 –

About this Part

In this activity, students will apply skills learned in Part 2 to create a dichotomous key for their "organisms" from Part 1.

Objectives

Students will develop a dichotomous key for the samples in Part 1.

Materials

- Completed Student Sheets from Part 1
- Student Sheet for Part 3 (One per group)
- Optional: Sample Dichotomous Key (One per group)
- Reserved samples from Part 1

Procedure

Advanced Preparation

Make copies of Student Sheet for Part 2

Classroom Procedure

Follow Student Procedure – see Student Sheet Part 3

Extension

As a homework assignment, students will be asked to identify and categorize a group of objects of their choice (Ex: tools, CD's, kitchen items, canned goods, etc.) and construct a flow chart and dichotomous key showing what characteristics they used to classify them.

Student Sheet Part 3
Student Procedure

1. Refer to both the Sample Dichotomous Key and to the Protist Dichotomous Key used in Part 2. Notice the different format for the same information that was recorded in Part 1.
2. Use the Chart that you made in Part 1 to remember the characteristics used to divide and subdivide the "organisms" into increasingly specific groups.
3. Starting at the top of the template on the Part 3 Student Sheet, take the first characteristic you used to divide the organisms and use it to write “present” or “absent” statements, 1.a. and 1.b. (Example 1.a. Round 1.b. not round)
4. At the end of statement 1.a., write the directions, "Go to statement 2."
5. On statement 2, choose the next characteristic that you used to divide 1.a. into two groups and write its presence or absence on statements 2.a. and 2.b.
6. Continue following the further divisions of group 1.a. until all organisms in that line are in a group by themselves and named.
7. At this point, go back to the top of the key and follow the above steps for all organisms that fall into group 1.b.
8. When your team has finished the key, trade it with another group that is finished. Provide the other group with the reserved organisms from Part 2.
9. Students in the other group should attempt to follow the first team's key and identify the organisms.